Detailed seismic velocity structure around the fault plane of the 2003 northern Miyagi earthquake by Double-Difference tomography

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A shallow M6.2 inland earthquake occurred on July 26, 2003 in the northern part of Miyagi Prefecture, northeastern Japan. The present 2003 northern Miyagi earthquake is one of the typical inland thrust earthquakes in NE Japan.

We obtained a detailed seismic velocity structure around the fault plane of this earthquake and its aftershock distribution by the double-difference tomography method [Zhang and Thurber, 2003]. Travel time data used are from temporary seismic stations [Umino et al., 2003] and permanent stations of Tohoku University, Japan Meteorological Agency and Hi-net.

Aftershocks are distributed in a westward dipping plane along which the estimated seismic velocities change abruptly. Both P-wave and S-wave velocities in the hanging wall are lower than those in the footwall. This observation suggests that the 2003 northern Miyagi earthquake occurred along a fault which was formed as a normal faulting in Miocene and is reactivated as reverse fault under the current compressional stress regime. Asperity, i.e. a large slip area of this earthquake [Miura et al., 2003] corresponds to the area with relatively high velocity. Low Vp/Vs ratio areas are detected along the aftershock alignment. This low Vp/Vs ratio could be interpreted as the existence of water-filled pores with high aspect ratio. Hypocenters of the mainshock, the largest foreshock and the largest aftershock are also located within the area with low Vp/Vs ratios.